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Instruction of Final Documentation

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Bachelor's thesis

Electrical Engineering

Vaasa 2018

BACHELOR'S THESIS

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Title: Instruction of Final Documentation

Date: April 19, 2018 Number of pages: 20 Appendices: 2

Abstract

This Bachelor's thesis was written for ABB's Power generation department in Vaasa. The main objective was creating a standard to make the Final design documentation process, more consistent in the projects being made. It also discusses documentation in general, and the importance of it.

At first, information was gathered from all designers and their projects. This information was then used to create a plan of what the Final design should include or exclude. There proved to be variations in project documentation, this made the process of creating a standard harder. However, a structure was put together and with the approval of a superior, the standard was created.

In order to cover the need of instructions for both beginner and experienced designers, two documents were made. One of them is a simpler yet clear layout structure for the more experienced designers. The other is a more in depth manual that can guide an unexperienced designer through the process of making the Final design. As a final result, both of these documents can now be implemented into the workplace, with the goal of increasing work efficiency and consistency.

Language: English Key words: Final design, documentation, manual, checklist, ABB

EXAMENSARBETE

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Utbildning och ort: El/ och automationsteknik, Vasa
Inriktningsalternativ: Automationsteknik
Handledare: Ronnie Sundsten, Tony Bäck

Titel: Instruktioner för Slutdokumentation

Datum 19.4.2018 Sidantal: 20 Bilagor: 2

Abstrakt

Det här examensarbetet är skrivet åt ABB:s avdelning Power generation i Vasa. Arbetet behandlar Final designen som är en slutdokumentering av de projekt som avdelningen arbetar med. Huvudmålet var att standardisera Final designen och göra den mera konsistent. Arbetet går även igenom generell dokumentering och vikten av den.

Till en början samlades information in från alla designers och deras projekt. Den här informationen användes sedan för att göra upp en plan för vad Final designen borde innehålla och utesluta. Det visade sig att det fanns variationer i projektdokumentationen, vilket gjorde det svårare att skapa en standard. Men en struktur skapades och med godkännandet från överordnade skapades standarden.

För att kunna täcka behovet av instruktioner åt både erfarna och oerfarna designers gjordes två olika dokument. Det ena är en lättare men ändå tydlig layoutstruktur åt de som är mer erfarna. Det andra är en mer ingående manual som kan vägleda en oerfaren designer genom processen av att skapa Final designen. Som ett slutresultat kan båda dessa dokument implementeras i arbetsmiljön. Målet var att med hjälp av instruktionerna kunna förbättra effektivitet och konsistens i arbetet.

Språk: svenska Nyckelord: Final Design, dokumentation, manual, checklista, ABB

Table of contents

1 Introduction

This thesis has been written for ABB OY and it consist of instructions regarding the final documentation within projects, at the modular power segment of the Power generation department at ABB. The department specializes in making control- and surveillance systems for power plants built worldwide, these systems have a final documentation called the Final design. An instruction manual and a excel checklist regarding the Final design have been made in addition to this document. It will also discuss documentation in general, and the importance of it.

2 Purpose

This bachelor's thesis was written to improve consistency in project documentation, specifically regarding the Final design. A clear and concise way of documenting is always beneficial, and the Final design's documentation varied depending on which designer had made it. This created the need for this bachelor's thesis as a way of trying to make a standard that can be used to increase consistency.

The purpose of this thesis is to create instructions on how to make the Final design and to provide a clear structure on how it should be done. It is meant to help both beginner and experienced designers at ABB Power generation modular power segment, in the making of the Final design package.

3 ABB

ABB is a technology leading company that works to build and develop the future of industrial automation and digitalization. As a global leader, they strive to improve the world with automation and power technologies (ABB, 2018). Each year, hundreds of millions of dollars are dedicated to research and development. Staying at a globally leading position requires a lot of hard work and dedication, this is something that ABB put great value in (ABB, 2018).

ABB was founded in 1988 as a result of two companies merging, ASEA and Brown Boveri. Both of these founding companies already had a long history of being some of Europe's best-known electrical engineering companies. The headquarters of ABB is located in Zurich,

Switzerland and as of December 2017, the company employs approximately 134800 employees worldwide (ABB, 2018).

In Finland, ABB is located in around 20 different places. The production is located at Hamina, Helsinki, Vaasa and Porvoo. In Helsinki, there are many products being made but mostly motors, generators, and frequency changers. In Hamina, they make Azipod thrusters, which is a kind of marine propeller. In Vaasa, production is focused around making motors, relays and automation/surveillance systems. In Porvoo, electrical installation products are made. ABB in Finland employs around 5300 workers (ABB, 2018).

3.1 Power generation

Power Generation at ABB is a leader in automation solutions and integrating power. They provide service to optimize efficiency and performance, while considering the environment. They provide solutions in many different kinds of power generating areas, such as wind, water, nuclear, gas and diesel. Power generation in Finland is located in Vaasa. It is a sub-division under Industrial automation, and it is the division this bachelor's thesis is written for (ABB, 2018).

4 Documentation

Nowadays there is a great need for concise and clear documentation. This is mostly due to the very complex world that we are currently living in. The more our technology and science develop, the greater the need of documentation becomes for each passing year. Without the proper documentation, work environments and processes will become cluttered very fast.

Documentation in general can come in many different forms. Some of the most usual means of documentation are manuals and instructions of different kinds. In addition, different reports and texts are also ways of documenting.

4.1 The importance of documentation

In today's hectic world, no one has the time do to anything deemed unnecessary. Documentation is often looked upon as unimportant or simply a waste of valuable time. However as earlier mentioned, the need for documentation has never been greater. In every workplace, people need to be able to communicate with each other in a clear fashion. For

this to happen there need to be clear instructions, texts and reports, on for example how a process or a machine works. “Technical writing must help, not hinder, the communication of complex ideas” (Shelton, 1996).

“Documentation in project management is not optional, it is mandatory” (Brown). As Brown mentions in his article, documentation is vital. Even though many people do not like the idea of having to spend hours documenting a certain process. It is vital for the project and even for the company. According to Brown, there are several different reasons to care about the documentation process.

1. Project management plan: The management plan needs to include a lot of different documentation. The decisions being made, minutes of meetings and problems needs to be documented. Otherwise, things will soon be forgotten and problems will occur as a result of it.

2. Project communication: The project communication is vital in order for anyone to catch up with the changes or decisions that have been done in the project. Communication in meetings and discussions needs to be documented and written in such a way that anyone would understand what is happening in the project.

3. Project reviews: Some companies use these reviews as an opportunity to see how the project is progressing. At the same time, the documentation will be looked at to see if it has been done properly. This is a good way for the management to get a better picture of how the process is handled.

When you start documenting your processes in order to stay in control over them, it often leads to improvement in results. The processes that are creating the biggest problems needs to be handled first. Only the processes that you are in control over are able to also be improved.

4.2 Benefits of documenting a process

No matter how hard you try, there will always be pros and cons with everything. However, when it comes to documentation, the pros outweigh the cons by a big margin. As earlier mentioned the most significant negative aspect is time. Nowadays time is a big problem for everyone. As the world develops, so does our busy schedule. Companies need to work harder and faster than ever before to fulfill the ever-growing demand and need for products at a

faster pace. The result is that a lot of time-consuming work like documentation is left behind. However when the documentation is lacking, the workflow will suffer thus reducing work efficiency. This will ironically lead to a loss of time where you earlier thought you were saving it.

The pros of documentation are plenty and easy to understand and adapt. According to the Management Study Guide (Juneja, 2016). There are both primary and secondary benefits to be gained by documenting. The main primary benefits are:

- **No Operational Ambiguity**: This is a very important thing to emphasize since it increases work productivity and efficiency. The time it takes when a person cannot understand what another person means, is time lost. Therefor the person making the manual or report needs to think from the reader's perspective. If this is done correctly, there will be no confusions later on in the work process thus saving valuable time.

- **Training Material**: This type of documentation serves as a means of educating the reader on a different topic or product. This is especially helpful when a new resource has been brought in. A proper training material documentation can then help the user to learn the things he needs to know, in order to do his work in the correct way. This will also save resources that would otherwise have been required to educate the new employee about his work.

- **Marketing Use**: In order for the marketing and sales team to know what they are buying/selling, they need to know the specifications of a certain product. In order for them to know that, they would need documentation that clearly states the information about the product. This will also help them make promises that the company actually can keep. Otherwise, there is always a risk of promising too much or too little, which can lead to a stressful relationship between companies.

The secondary benefits to documentation can be analysis of a work process. A process that is well documented is easier to analyze and can be studied by the management. This can then help the management see the process and how it is currently implemented. Improvements can then be made if necessary.

4.3 How to document properly

There are two essential functions that needs to be included in the documentation. The first and most important one is to make sure that the project requirements are met. This is self-explanatory since it obviously is the whole idea of a project. The second essential function is that the user should be able to go back and see what and how a certain thing has been done. It should also state who has done it and where it has been done. The documentation process also needs to be well structured and easy to understand (Theriault, 2013).

A few things to think about when it comes to creating documentation is to use:

- **Flowcharts**: The use of flowcharts is a popular method to help someone understand a process. They can also be broken down into several small flowcharts to help explain a certain process within a project. It is important to try to convey the big picture to the reader.

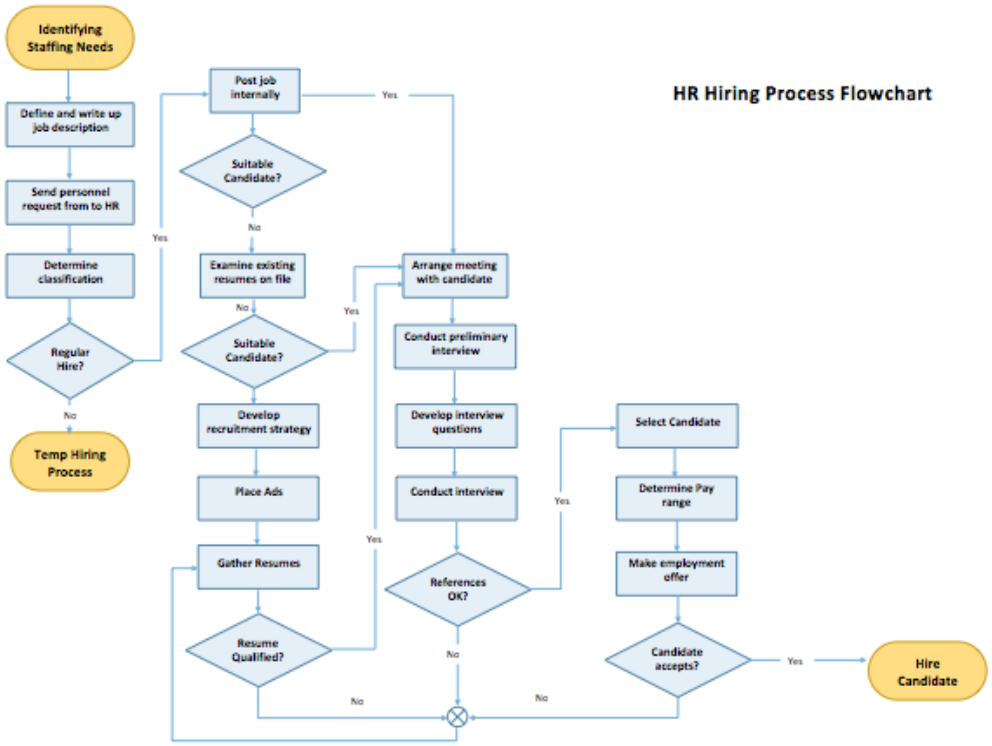


Figure 1 Example of a Flow Chart (Microsoft, 2017)

- **Checklists**: Checklists are a good way of making sure that the user includes all the information needed within a process. They are fairly short and simple but they can guide the user in a very clear way.

- **Graphics**: A picture says more than a thousand words. A graphic image can tell the user many things that otherwise would be lost in rows of text. For example, a red button or a stop sign can really emphasize the importance of a certain step within a project. Visual aid is for the most time a benefit when it comes to documenting a process.

- **Keeping it short**: In order for the reader to get a clear message, it is important to keep the text as short and concise as possible. Keeping the text in short sentences and using images and checklists will help the user to understand the process quicker.

- **Considering the user**: Often if the creator has a lot of experience with the process, steps that he might think is obvious, might be left out of the documentation. This can turn out to be a problem if the user does not have the same experience with the process. Therefor it is important to explain everything as simple as possible in order for everyone to understand each other.

- **Creating a clear structure**: Especially for longer documents, it is important to make a clear structure. Splitting the document into main- and subsections can be a good tool to help the creator with this.

- **Explaining yourself**: We all think differently and work in different ways. Therefor it is important to explain why certain steps are more important and how to understand them. In one way or the other, the process needs to be explained. Understanding the process but also the human mind is important in order to make a clear and concise documentation (Theriault, 2013).

5 Final Design

The Final design is a package consisting of documents that are made for all projects at the Power generation modular power segment. The Final design is the final documentation regarding the control- and surveillance systems being made by the division. These systems are used to control and supervise different kinds of power plants worldwide. It is a vital part of the project and as the name implies it is one of the final stages of a project. The Final design is important because it gives the customer documents that they need, in order to manage the product in a safe and proper way. In the following sections I will go through the different parts of the Final design. I will explain what their use are and why they are needed.

5.1 Panel drawings

The drawings usually have so called red-pen markings, which tells the designer what needs to be adjusted in the drawings. Since the panel already has been built in this stage of the project, the markings are made from the test area. These changes have been made due to modifications or corrections in the panels. These changes then need to be properly implemented in the drawing software. When these drawings have been revised, the designer prints a set of both internal and external lists for the respective drawing. These lists will be discussed later on. The designer will then print the drawing into a pdf and start putting the pieces together.

A document called the list of drawings, which will be discussed further on, will be made and adjusted according to the current project. The different lists are then added to the panel drawings. The whole document is then saved as a pdf-file and uploaded to the ABB network, inside the correct project folder. This is done for all the drawings within the panel.

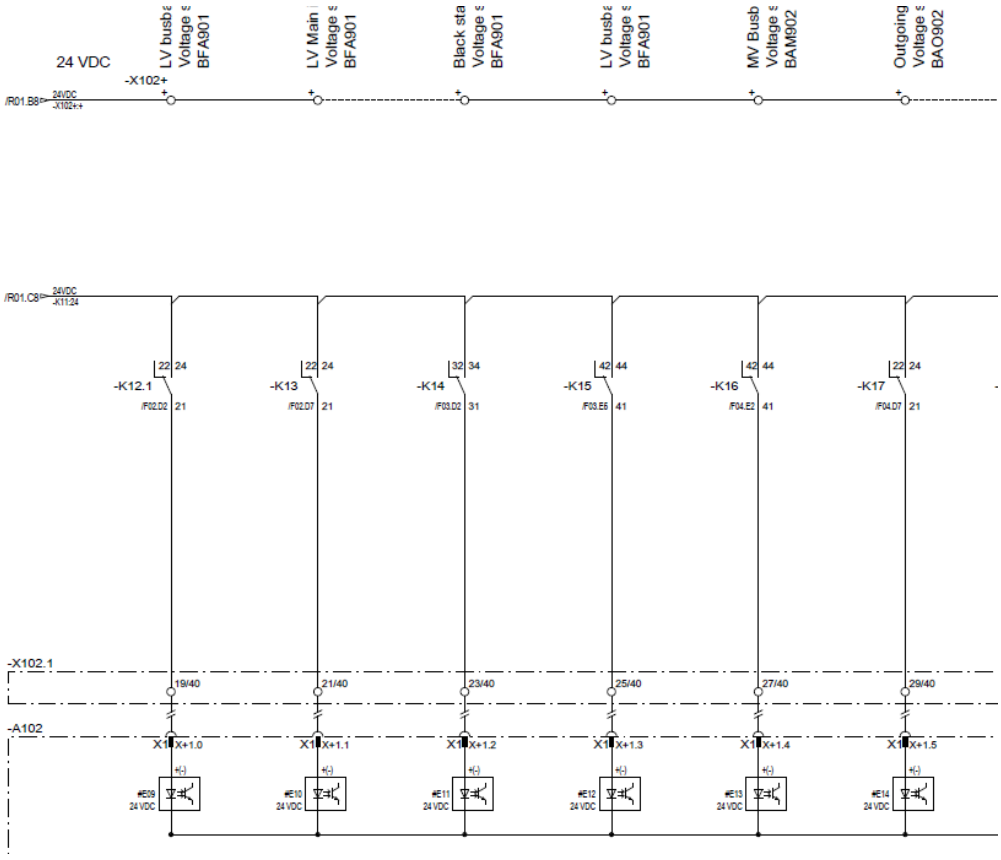


Figure 2 A part of a Panel drawing (ABB, 2018)

5.1.1 Internal lists

The internal lists are a built-in function inside the drawing software. This allows the user to create these lists with a simple press of a button. The internal lists that need to be created are the List of content, Terminal connection list, Connection list and Parts list.

- The List of content is generated at the beginning of the drawings. This list shows the user some information about all the different pages of the drawing and what they consist of. It works as a Table of contents.

- The Terminal connection list shows the user all the different connections inside a project and to what terminals they are connected to.

- The Connection list shows all internal connections in the panel.

- The Parts list shows the user all the parts that exists within the panel.

	Sheet	n.sh.	Description 1	Description 2
A	A01	A02	Title page	
	A02	A03	List of contents	A01 - R07
	A03	A04	List of contents	R08 - X31
B	A04	A05	List of contents	X32 - Z11
	A05	A10	List of contents	Z12 - Z15
	A10	A11	Front view	
	A11	A12	Inside view	
	A12	A13	Bottom view	
	A13	A14	Floor layout	
C	A14	A25	Cable shield earthings	
	A25	B01	List of labels CFA801	
	B01	B02	24 VDC Supply	
	B02	B03	24 VDC Supply	
	B03	F01	24 VDC Supply	
	F01	F02	Synchronizing diagram	
D	F02	F03	Synchronizing diagram	
	F03	F04	Synchronizing diagram	
	F04	F05	Synchronizing diagram	
	F05	F06	Synchronizing diagram	
	F06	F07	Synchronizing diagram	
	F07	F08	Synchronizing diagram	
	F08	F09	Synchronizing diagram	
E	F09	F10	Synchronizing diagram	
	F10	F11	Synchronizing diagram	
	F11	F12	Synchronizing diagram	
	F12	F13	Synchronizing diagram	
	F13	F14	Synchronizing diagram	
	F14	F15	Synchronizing diagram	
	F15	F16	Synchronizing diagram	
	F16	F17	Synchronizing diagram	

Figure 3 Example of a List of contents (ABB, 2018)

5.1.2 External lists

The external lists consist of the Cable list and the Cable connection list. These lists are also made in the drawing software however, they need to be manually edited in order to include all the information needed. The Cable list consists of all the cables within the panel being worked on. It shows the cable number and type being used. It also shows from what panel and to which panel it is connected. This makes it a very important list since there usually are many different cables within a project, and keeping them organized is very important.

In addition to the cable list, the cable connection list also shows the pin that the cable is connected to. It also has a drawing reference to show the user where in the drawing the cable is found.

ABB

Connection List: Cables

Generated: 2017-10-27

Cable		Wire/Conductor	From			To		
Name	Type	Name	Location	Pin	Screw	Location	Pin	Screw
-51 001	4x2.5mm²	1	+CFA901	-X1:1	E	+BAM901	-XDV:11	
-51 001	4x2.5mm²	2	+CFA901	-X1:2	E	+BAM901	-XDV:13	
-51 001	4x2.5mm²	3	+CFA901	-X1:3	E	+BAM901	-XDV:15	
-51 001	4x2.5mm²	4						
-51 002	4x2.5mm²	1	+CFA901	-X1:4	E	+BAO901	-XDV:11	
-51 002	4x2.5mm²	2	+CFA901	-X1:5	E	+BAO901	-XDV:15	
-51 002	4x2.5mm²	3						
-51 002	4x2.5mm²	4						
-51 003	4x2.5mm²	1	+CFA901	-X1:6	E	+BFA901+0301	-X12:25	E
-51 003	4x2.5mm²	2	+CFA901	-X1:7	E	+BFA901+0301	-X12:30	E
-51 003	4x2.5mm²	3						
-51 003	4x2.5mm²	4						

Figure 4 Example of a Cable connection list (ABB, 2018)

5.1.3 List of drawings

The list of drawings exists as a guide when you open the document. As it is the first page you come across when opening the panel drawing. The list of drawings shows how many pages the different sections of the document have and what revisions they are currently on.

This list is very important as it tells the user directly what the document consists of, the current revision and document number.

ABB

List of drawings

Location	Title	Document	Document number	Pages	Revision
+CFA901	Common control panel	List of drawings	CBG035341 01 A2001	1	
+CFA901	Common control panel	E3 Drawings	CBG035341 01 A1001	182	B
+CFA901	Common control panel	Cable list	CBG035341 01 A4001	2	B
+CFA901	Common control panel	Cable connection list	CBG035341 01 A5001	23	B

Figure 5 Example of a List of drawings (ABB, 2018)

5.1.4 PDF Xchange Editor

The drawings and their respective lists are put together with PDF Xchange Editor. The drawing is edited and the list of drawings is put as the first page of the document. After the drawings, the cable list is added. Finally, the cable connection list is added after the cable list. The purpose of this is to make one document per panel where all the information can be found. The documents are uploaded to their designated folder in the Final design structure.

5.1.5 Principal earthing drawing

The Principal earthing drawing is the drawing that shows all the main earthing and earthing interconnections within a panel. Because of this, the drawing is an important part of the Final design and it is located in the common control panel folder in the Final design structure.

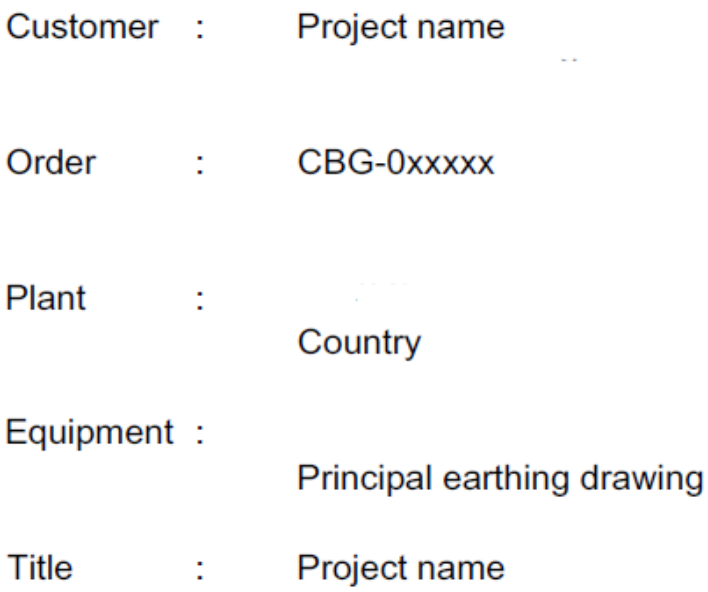


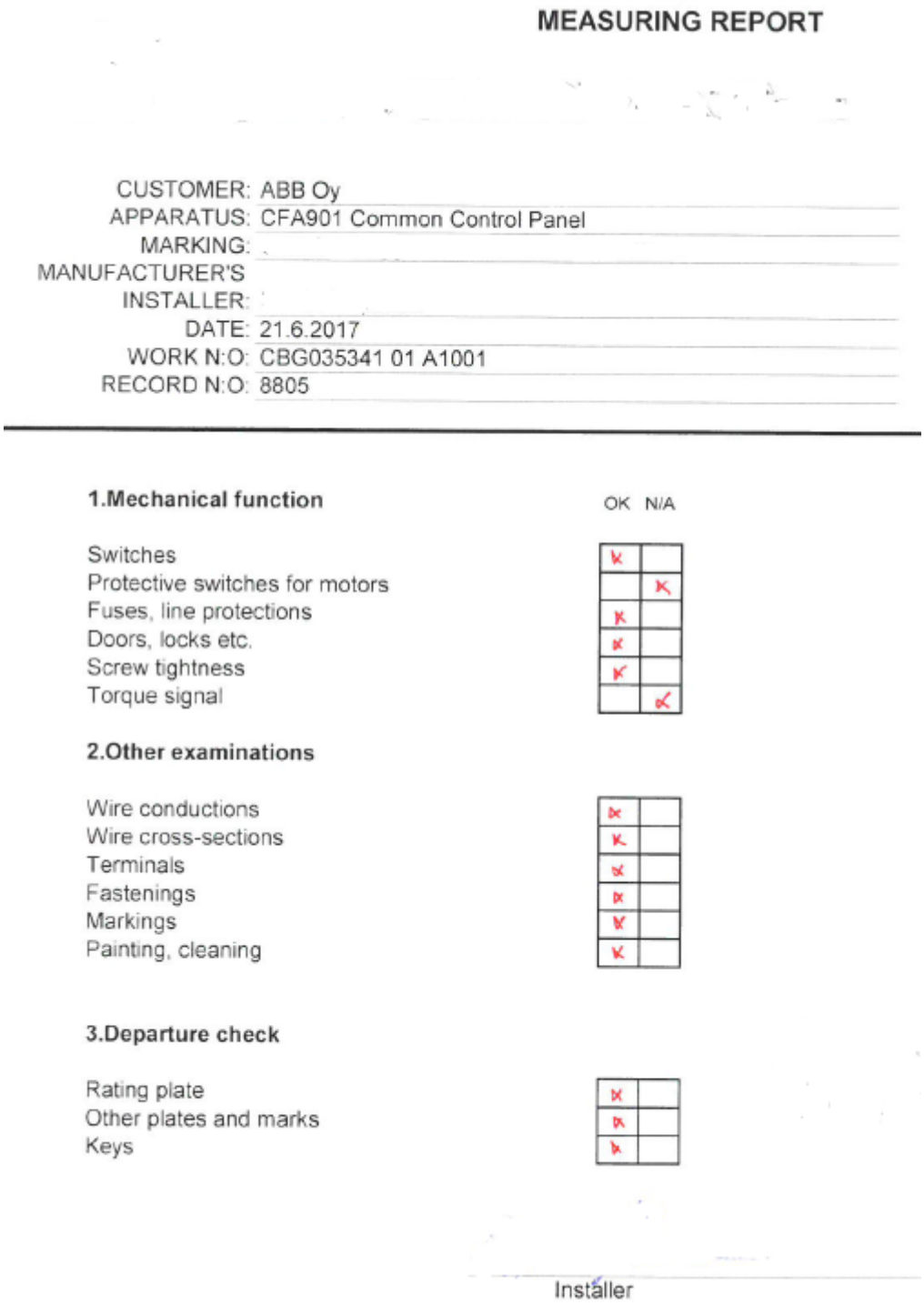
Figure 6 First page of a Principal earthing drawing (ABB, 2018)

5.2 Test protocols

When the panels arrive from the manufacturer, they will send corresponding test reports and results along with the panels. These reports are saved for later alongside ABB's own test reports that are created during the testing phase of the panels. All of these reports are then scanned by the designer and put inside the test protocol folder, in the Final design package. These test results are important for the customer to have in case something would be missing or damaged, when the product arrives to the customer.

5.2.1 Manufacturer test reports

The manufacturer that makes the panel will send test reports proving that the panel has been thoroughly tested for basic functions. These reports have to be scanned and sent to the customer. There is always at least one report per panel. Figure 7 shows an example of a test report sent from the manufacturer.



MEASURING REPORT

CUSTOMER: ABB Oy
APPARATUS: CFA901 Common Control Panel
MARKING:
MANUFACTURER'S
INSTALLER:
DATE: 21.6.2017
WORK N:O: CBG035341 01 A1001
RECORD N:O: 8805

1.Mechanical function	OK	N/A
Switches	X	
Protective switches for motors		X
Fuses, line protections	X	
Doors, locks etc.	X	
Screw tightness	X	
Torque signal		X
2.Other examinations		
Wire conductions	X	
Wire cross-sections	X	
Terminals	X	
Fastenings	X	
Markings	X	
Painting, cleaning	X	
3.Departure check		
Rating plate	X	
Other plates and marks	X	
Keys	X	

Installer

Figure 7 Manufacturer test report (ABB, 2018)

5.2.2 FAT inspection and test reports

The designer fills in the FAT inspection and test reports, during the testing of the panels. The reports found here are the following: ABB inspection and test report, BJA inspection and test report and the FAT test report. Finally, for the automatic voltage regulator, a test

certificate is included. These reports are filled in and scanned into pdf before being uploaded to the portal.

The ABB inspection and test report consists of mainly configuration and functional tests. Things being tested here are for example the PLC system, WOIS/WISE, Ethernet connections and I/O checks. In the BJA inspection and test report, the BJA panel is being tested and inspected. The panel is visually inspected and manually tested for malfunctions. The FAT test report is similar to the ABB test report, the difference being that the FAT report includes more documentation. It also includes visual checks, and testing if instruments and relays are functioning properly. The automatic voltage regulator is tested and inspected in a similar fashion, and the results are documented.

5.2.3 Monitoring system

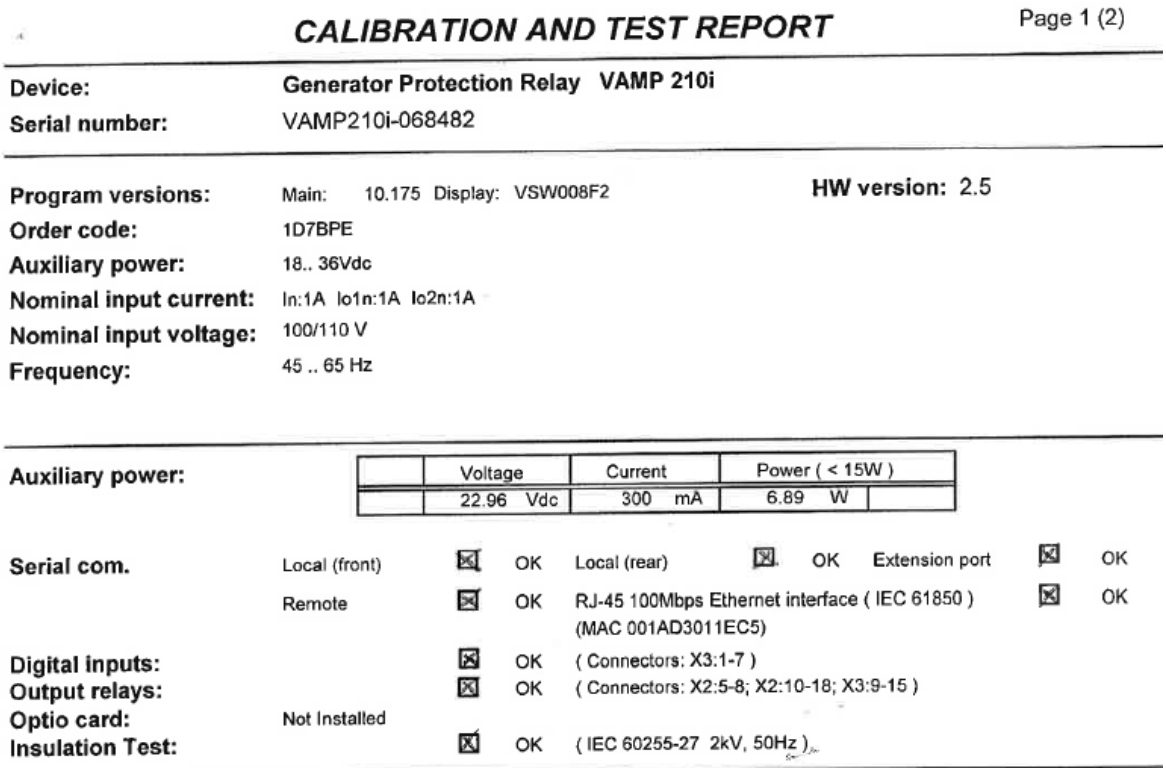
In this folder different kinds of automation related documents are found. These files include the Monitoring system, WISE/WOIS screens, sysclean and asset information. The project's WOIS engineer is the one who creates these files. They are also responsible for uploading these files to the portal. The WOIS is the software used for control and surveillance of the panels.

The monitoring system tells the user about the control system's supervision. It has information about the workstations, servers, gateways and IP addresses. The WOIS is the software from where the system is being controlled. In the WOIS screens, all the different screens from the WOIS are found. The WISE is the software from where the system reports are shown. Here one can find for example data and a logbook, which can tell the user information about what is happening in the system. The WISE screens show all the different screens found in the WISE.

5.2.4 Protection relay settings and test reports

The protection relay settings and test reports document is usually made and filled in by the project engineer. This is needed when testing the generator protection relay, power monitoring unit and differential protection relay. There are many different kinds of protection relays and the customer is usually the one who decides which one they want to use. Depending on the protection relay, the corresponding test report is used.

The protection relay settings and test reports shows information about the relay being used. It shows the relay settings so that the user know what values are being used. If for example a VAMP relay is used, the VAMP calibration and test report is used. These reports come from the manufacturer and contain information about the relay and its settings.



CALIBRATION AND TEST REPORT Page 1 (2)

Device:	**Generator Protection Relay VAMP 210i**
Serial number:	VAMP210i-068482
Program versions:	Main: 10.175 Display: VSW008F2 **HW version:** 2.5
Order code:	1D7BPE
Auxiliary power:	18.. 36Vdc
Nominal input current:	In:1A Io1n:1A Io2n:1A
Nominal input voltage:	100/110 V
Frequency:	45 .. 65 Hz

Auxiliary power:

	Voltage	Current	Power (< 15W)
	22.96 Vdc	300 mA	6.89 W

Serial com.	Local (front)	☒	OK	Local (rear)	☒	OK	Extension port ☒ OK
	Remote	☒	OK	RJ-45 100Mbps Ethernet interface (IEC 61850) (MAC 001AD3011EC5)			☒ OK
Digital inputs:		☒	OK	(Connectors: X3:1-7)			
Output relays:		☒	OK	(Connectors: X2:5-8; X2:10-18; X3:9-15)			
Optio card:	Not Installed						
Insulation Test:		☒	OK	(IEC 60255-27 2kV, 50Hz)			

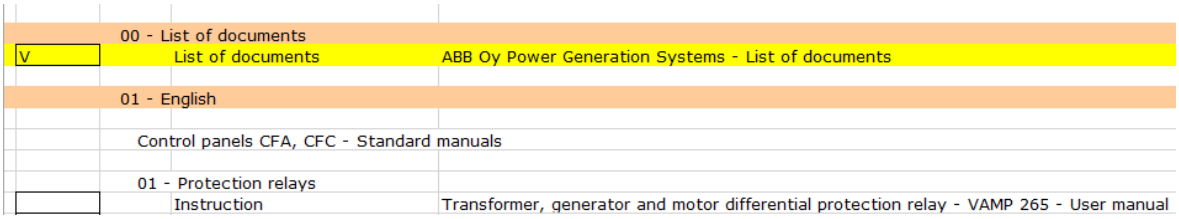
Figure 8 Example of a VAMP210 test report (ABB, 2018)

5.3 Manuals

Many different components are used when making a project of this size. Some of these parts have manuals that are not included in the project by default. In the case of missing manuals, it is up to the designer to find and upload them to the Final design package. These manuals are then sent to the customer. It is of course vital that the customer gets the correct manuals, in order for them to handle the system in a safe way.

5.3.1 ABB Doclist

The ABB Doclist is an excel document that contains many different manuals. The engineer needs to check the parts included in the project and find them in the ABB Doclist. This makes it clear what manuals need to be sent along with the project. However, some manuals may not appear here, these manuals need to be sent manually to the customer as explained earlier.

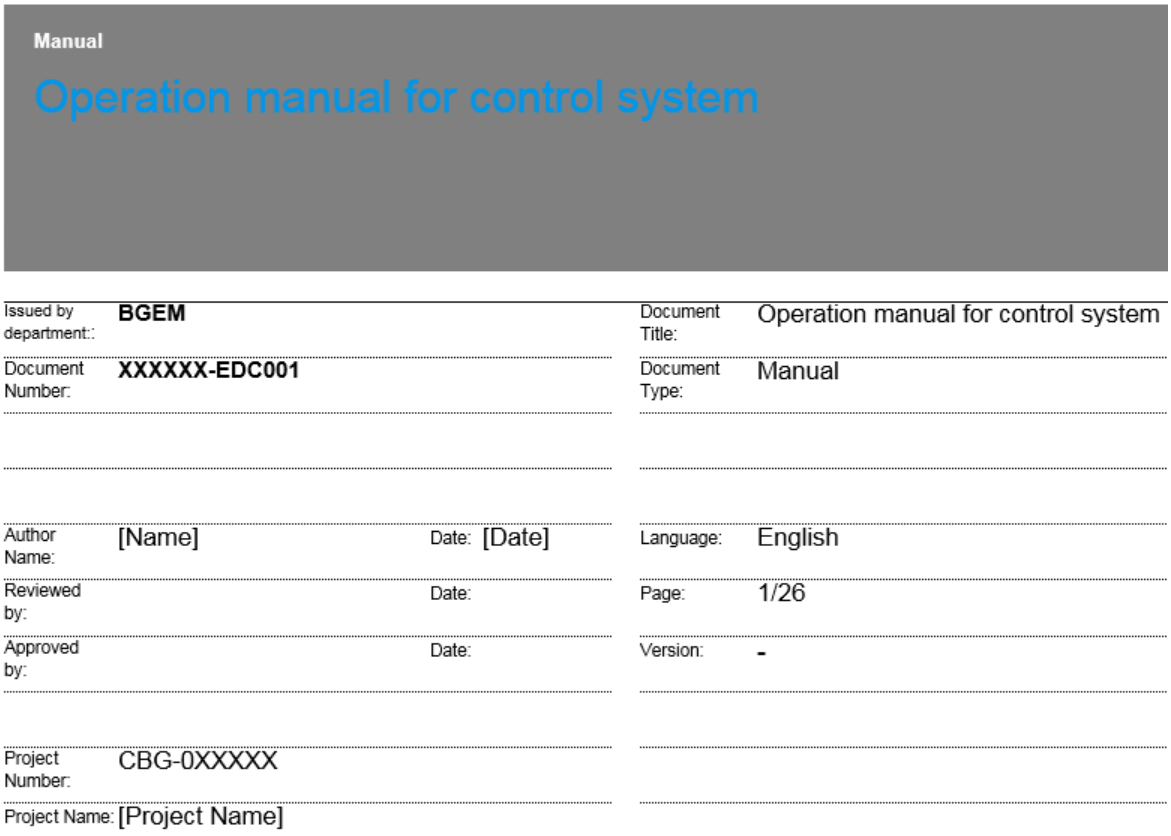


	00 - List of documents	
V	List of documents	ABB Oy Power Generation Systems - List of documents
	01 - English	
	Control panels CFA, CFC - Standard manuals	
	01 - Protection relays	
	Instruction	Transformer, generator and motor differential protection relay - VAMP 265 - User manual

Figure 9 a part of the ABB Doclist (ABB, 2018)

5.3.2 Operation manual

The operation manual works as a quick guide on how the panel's interface is used and how the panel is started. This manual is important because it quickly instructs the customer on how the system is used.



Manual

Operation manual for control system

Issued by department::	**BGEM**	Document Title:	Operation manual for control system
Document Number:	**XXXXXX-EDC001**	Document Type:	Manual
Author Name:	[Name]	Date: [Date]	Language: English
Reviewed by:		Date:	Page: 1/26
Approved by:		Date:	Version: -
Project Number:	CBG-0XXXXX		
Project Name:	[Project Name]		

Figure 10 a part of the Operation manual (ABB, 2018)

6 Creating the instruction

In order to make this project usable for both beginner and experienced designers, two documents where created for ABB. The Final design manual made for beginners is more explaining, in terms of instructing the reader about how to make the Final design package.

The Final design checklist made for the more experienced designers serves more as a tool. Its purpose is to aid the designer in a simple way to make the Final design.

At first, a clear structure and layout to show what the Final design should look like had to be made. This proved to be quite challenging since it seemed as everyone made the Final design a bit different from one another. Different projects had to be compared from all the different designers, and a conclusion had to be made with a superior on what it should look like.

There are some documents that are always included, and a lot of work was needed to find out which those documents were. All the different documents that could be found in the designers' versions of the Final design were looked at. The practical and theoretical use of the different documents where then analyzed. From discussions and interviews with a supervisor, the documents that needed to be included or excluded from the Final design were determined. Now when the Final design's content had been figured out, focus shifted towards structuring the whole thing.

When making the documents both experienced and beginner designers' perspectives had to be considered. This was important in order to be able to help both groups of people without making it too hard.

6.1 Final design manual

The Final design manual (appendix 1), was created mainly for a new employee. It uses clear steps and pictures to instruct the user on what to do. Creating this manual was a bit easier since it was more familiar. Since this position was familiar, it was easier to relate to what a new employee would feel and think. This made the process a lot easier, especially in terms of explaining all the different procedures included in the Final design.

At first the writing was made as easily as possible, using many pictures to help the reader understand. Later the different sections where divided into smaller ones, and each step was carefully explained. Since there are so many steps included when making the Final design, it was important to make sure that the document did not become cluttered. When it was finished, the final version was sent to a superior for approval.

6.2 Final design checklist

If you are an experienced designer, you most likely will not need a systematic manual to do your work. The checklist (appendix 2) is a simple checklist that shows the structure of the Final design. This checklist can help anyone make the Final design, assuming you already have experience from doing it.

The challenge in making this checklist was to establish a working layout for the Final design. Since there are so many designers and no clear instruction on how to do it, results varied depending on the designer. For this process, information was gathered from all the designers and some of their projects. The results were then compared, and a decision was made on what the structure should look like.

The problem with this list was that there were variations in how the designers made the Final design. However, by looking at the design one document at a time, the decision of what to include or exclude from the final structure was easier to make. Another problem that occurred was that the documents included in the Final design sometimes change, depending on the project. Although many of the documents most likely will be in the Final design, it depends a lot on the project which documents will be included. An important step was to realize that the Final design will change from project to project but that the intention should be to follow the standard as closely as possible.

The checklist was structured in such a way that the left column consists of the Final design structure and checkboxes. The right column consists of links to examples that shows the user documents on how it could look like when it is finished. It also holds useful links to general documents that are helpful, when making the Final design. These general documents are documents that are always included, and they do not change much between projects.

The checkboxes are used because there are many different documents to keep in mind. Therefor it helps to have something that keeps track of everything. After a certain document has been created or added you can simply check it off and move on to the next document.

Instruction of final documentation		Examples
Note! These documents are project specific. Some documents will change depending on the project.		
D04 Customer documents		General documents
		Document numbering
D04_03 yyyy-mm-dd Final design		
01_Common control panel CFA90_		
CFA901	☐	CFA901
Principal earthing drawing	☐	Principal earthing drawing
02_Genset control panel CFC0_1		
CFC0_1	☐	CFC0_1
03_Local control panel BJA0_1		
BJA0_1	☐	BJA0_1
04_AVR panel CFE0_1		
CFE0_1	☐	CFE0_1
05_Server rack CWC901		
CWC901	☐	CWC901
06_Automation layout		
Automation layout	☐	Automation layout
0n_Test protocol*		

Figure 11 a part of the Final design checklist

7 Result

The purpose of this thesis was to create instructions that would aid both experienced and beginner designers in making the Final design. It was also meant to increase the consistency in project documentation. This resulted in two different documents being made for ABB, the Final design checklist and the Final design manual. These two documents can now be used by ABB and they can also be updated if needed.

The result of this bachelor's thesis has been that the documents that have been made, may now be implemented into everyday use. The Final design manual and the Final design checklist have not yet been tested by everyone, but should improve the quality and efficiency of work at the Power generation modular power segment.

7.1 Testing

So far, only I have done the current testing and according to me, they help keeping things organized and structured as intended. The manual can be of assistance when a new employee

needs to be instructed on how to make the Final design. This can save time and assets that would otherwise have been put into teaching a new employee how to do their job.

The designers' testing of both the Final design manual and the Final design checklist are still to be made. They will be presented to the designers at ABB, and introduced as a way of relieving the workload. The intention is that everyone will be able to make use of these documents to increase the working efficiency.

7.2 Improvements

There can always be improvements and extensions to these kinds of documents. The intention is to keep the documents updated as changes may occur. For example, in the future improvements and clarifications regarding the drawings could be made. Extending these kinds of standards can also make a new employee learn their task even faster.

8 Discussion

When I started writing this thesis, I did not know what to expect. It felt very hard to wrap my head around the task. An otherwise busy schedule made it hard to get started and it all felt a bit overwhelming at first.

The most challenging part was to create distinct boundaries regarding what to include and exclude. When I had made it clear to myself that I needed to make two different documents, the pieces started falling in place. I could focus on one document at a time and think thoroughly about what to include in each document.

The Final design manual was easier for me to make. As I had worked the entire summer doing this kind of work myself, it was easier to imagine how a new employee would look at things. The Final design checklist proved to be more of a challenge. I now had to try to think what would help a designer that had already worked at ABB for let us say 15 years. After a lot of questions and thinking, I figured it would be best to make a checklist. A simple list that could help the designer keep track of all the different documents, since this is the main issue with the Final design.

I have learned a lot, writing this thesis. It has reminded me of how different everyone is and how different we all perceive things. We often tend to believe that everyone thinks the same way as us. You usually find out that this is never the case. By creating a manual, I really had

to start thinking about how others perceive things. Something that might be obvious to me might not be obvious to someone else. I have also learned the importance of planning, structure and documentation. A thing that is left undocumented often tend to be forgotten. It is vital to document a process in order for it to improve and develop. This is something that I had not put much thought into before writing this thesis.

I feel as if this thesis and the documents created can be of assistance in the everyday work here at ABB. My wish is that it could be implemented and used as a standard. I think that the purpose of this thesis has been fulfilled and met with a decent result. A result that can be easily updated if any major changes were to be made.

Finally, I would like to thank Mr. Tony Bäck at ABB and Mr. Ronnie Sundsten at Novia UAS for guiding me through this process. I would also like to thank my supervisor Mr. Tom Aura at ABB for this opportunity.

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